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Determining Potential Corn Rootworm Populations and Residual Effectiveness of Insecticides

J. B. POLIVKA

O. K. HEDDEN

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER
WOOSTER, OHIO

CONTENTS

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AGDEX $\frac{111}{622}$

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Determining Potential Corn Rootworm Populations and Residual Effectiveness of Insecticides

J. B. POLIVKA[1] and O. K. HEDDEN[2]

INTRODUCTION

It is of considerable importance to determine the population of northern corn rootworm *Diabrotica longicornis* (Say) larvae in fields where research work is to be conducted and where corn is to be planted. Some research workers use the number of overwintering eggs as an index of the potential population in fields in which they are planning to conduct corn rootworm research. In Ohio, it was decided to determine the potential population on the basis of the number of larvae reared in the greenhouse during the winter months from soil taken from fields in which research work is planned. This also would show the residual effectiveness of various insecticides used in 1966.

PROCEDURE

During November and December 1966, varying numbers of soil cores were taken from different fields and from soil areas treated with insecticides. The soil plugs were 7x7x7 inches, with the old corn plant root system in the center. These cores were taken to a greenhouse at the Ohio Agricultural Research and Development Center, Wooster. The soil was removed from the old plant root system and placed in 8-inch clay pots. As soon as the soil warmed up to 70° F., four kernels of corn were planted in each pot of soil. Approximately 2 months later, the soil in the pots was examined for larvae, pupae, and adults of the northern corn rootworm.

The insect populations shown in Tables 1 and 2 were obtained by breaking up the soil by hand after it was taken from the pot and dropping it into a bucket of water. The soil was left in the water for about 30 minutes, with an occasional stir to break up the clods and to hasten the rise of the larvae, pupae, and adults to the surface.

To check on the efficiency of this method, the buckets containing the soil and water were left standing overnight. When these buckets

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[1]Professor of Entomology, Ohio Agricultural Research and Development Center, Wooster, and The Ohio State University, Columbus.

[2]Research Agricultural Engineer, Agricultural Research Service, U. S. Department of Agriculture, Wooster, Ohio.

TABLE 1.—Potential and Actual 1967 Northern Corn Rootworm Populations in Field 1 at the Western Branch, OARDC, South Charleston, Ohio.

Sample No.	Potential Population per Core of Soil				Average Actual Population per Core of Soil
	Larvae	Pupae	Adults	Total	
1	17	2	1	20	10
2	15	3	0	18	19
3	27	5	2	34	27
4	35	2	1	38	33
5	25	4	2	31	15
6	87	7	1	95	11
7	30	4	0	34	5
8	19	0	3	22	5

Fig. 1.—Washing tank with overflow, catching screen, and drain basin.

were checked the following day, one to five larvae were found floating on the water surface in many buckets.

This method of determining the insect population in each pot was time consuming. Therefore, soil washing equipment was constructed

TABLE 2.—Potential and Actual 1967 Northern Corn Rootworm Populations in Field 2 at the Western Branch, OARDC, South Charleston, Ohio.

Corn Variety	Number of Cores	Potential Population per Core of Soil				Average Actual Population per Core of Soil
		Larvae	Pupae	Adults	Total	
760	24	110	51	8	169	80
C54	24	211	37	13	261	71
C38	24	179	48	4	231	77
WF9x51a	24	137	49	10	196	82

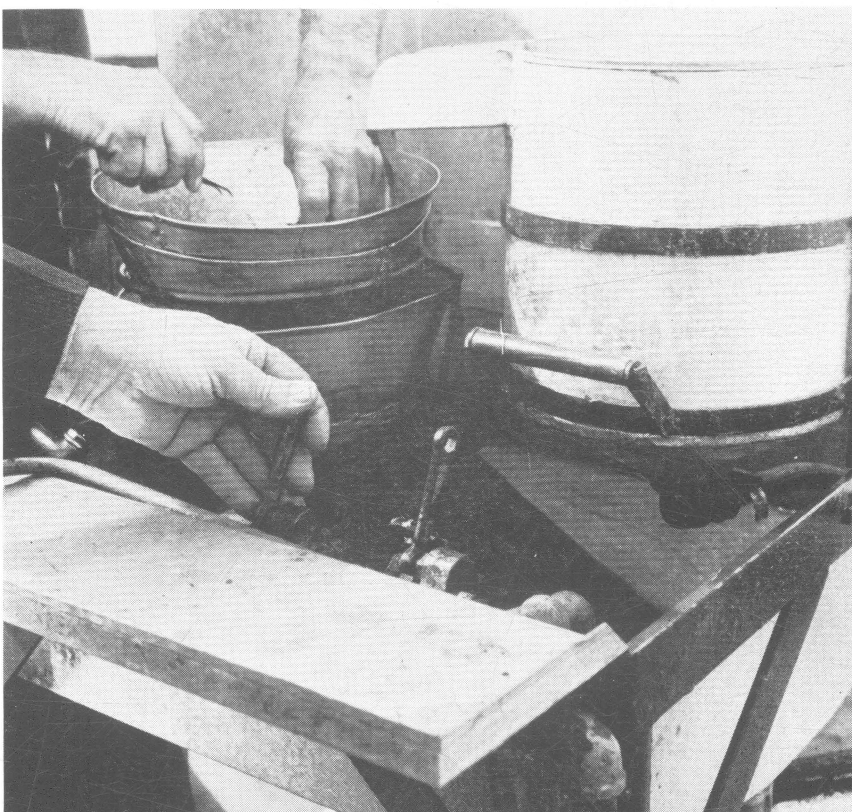

Fig. 2.—Control valves regulate flow to bottom of washing tank.

to speed up the process of making the larval counts, as well as to improve the efficiency of the washing operation.

This soil washer consists of a washing tank with overflow, catching screens, and drain basin (Fig. 1). The washing tank has a fitting in the bottom which is connected to a water line through an adjustable flow valve and a full flow valve (Fig. 2). The adjustable valve enables the operator to control the velocity of flow into the bottom of the washing tank. After this adjustment has been made, the full flow valve permits water to be turned on and off without changing the selected flow rate.

The bottom tank fitting has drilled openings which form and direct jets of water entering the bottom of the tank in a circular upward direction into the soil sample, washing the soil and roots apart and off the tank bottom. This separates the soil particles and other non-buoyant parts

Fig. 3.—Washing tank can be dumped and the tank flushed clean to receive next sample.

of the sample from material which floats in water. This material then floats out the overflow onto the first screen, where the coarse material is retained. Openings in this screen are about 1.296 mm (14x14 mesh with .020 inch wire). The material passing this screen is retained on the bottom screen, which has an opening of about 0.4 mm (40x40 mesh with 0.010 inch wire). Water passes through the screen into the drain basin (Fig. 1).

The washing tank is hinge mounted so that the washed sample can be dumped and the tank flushed clean, ready to receive the next sample (Fig. 3). The catching screen are removable, permitting the operator to examine the debris on the screen. The screens may be removed to a work area for closer inspection (Fig. 4). After inspection, the screens are flushed clean with water and returned to the washer to receive material from the next sample.

During the first few days that this method was used, a few larvae were found in the residue water. At the end of the washing period,

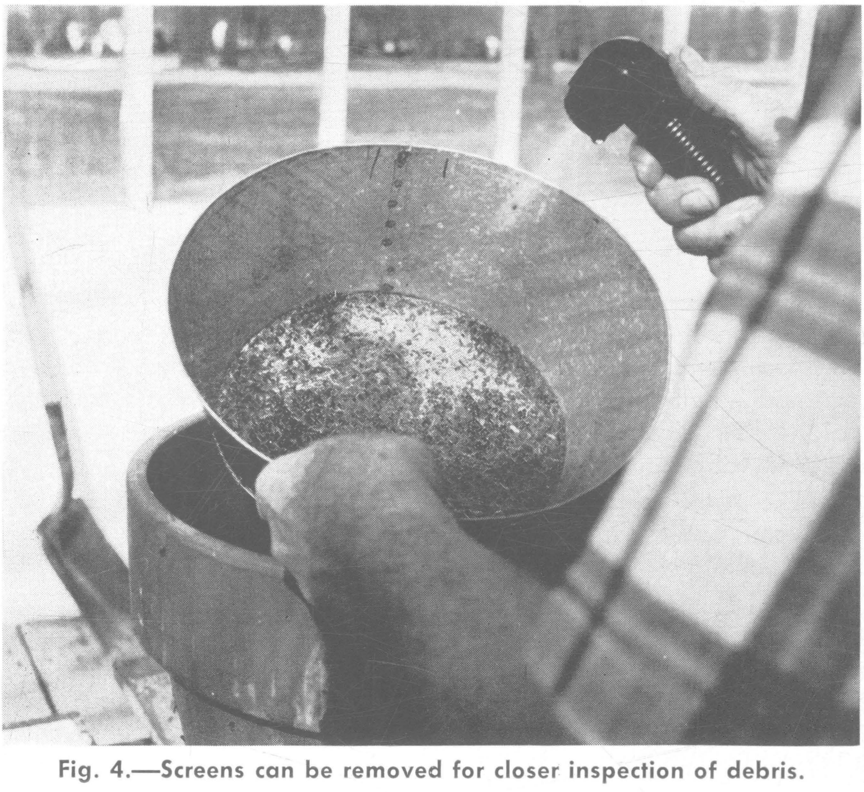

Fig. 4.—Screens can be removed for closer inspection of debris.

however, only occasional insect specimens were recovered in the residue. This indicates that this method is better than the bucket method.

RESULTS

Field 1: The data in Table 1 were obtained from soil cores taken from a field at the Western Branch, Ohio Agricultural Research and Development Center, South Charleston. The field was in continuous corn for 5 years and had never been treated with an insecticide. This field was used to evaluate the effectiveness of insecticides against the corn rootworm in 1967.

Eight soil samples were collected November 23, 1966. These were taken immediately into the greenhouse and placed in pots. Corn was planted in the pots on November 26. Between January 27 and February 8, 1967, the soil was examined for larvae, pupae, and adults. This field was checked again in 1967 to determine the actual larval population per corn plant.

The data show that the potential population averaged 36.5 larvae around the roots of the 1966 corn plants and the actual population averaged 15.6 larvae around the roots of the 1967 corn plants. The actual recovery amounted to 42.7 percent of the potential population.

Field 2: The data in Table 2 were obtained from soil cores taken from another field at the Western Branch. This field had been in continuous corn for 5 years. In 1964, the area was used to evaluate different unlabeled insecticides. In 1965 and 1966, the field was used to evaluate the effects of plowing and planting dates on the corn rootworm population.

The soil cores were collected November 28, 1966. These were taken immediately to the greenhouse and the soil was placed in clay pots. Corn was planted in the pots a few days later. The soil was examined for the different stages of the insect during the period from February 2 to 18, 1967. The field was sampled again in July 1967 to determine the actual larval population on the small corn plants.

The insect population averaged 8.9 around the roots of the 1966 corn plants and 3.2 around the roots of the 1967 corn plants. The actual population was only 36.0 percent of the potential population.

Field 3: The data in Table 3 were obtained from soil cores taken from a field near Upper Sandusky, Ohio, where the insect has been found resistant to the chlorinated hydrocarbon insecticides. This field had been in continuous corn for a long period except for 1964. On December 15, 1966, four soil cores were taken from each of 10 different treatments which had been applied to the 70-acre field. The soil was potted

TABLE 3.—Residual Effectiveness of Different Insecticides and 1967 Potential Northern Corn Rootworm Populations Near Upper Sandusky, O.

Treatment	Population: Larvae	Pupae	Adults	Total	Average Actual Population per Core
Bux	48	3	0	51	12.3
Disulfoton	18	2	0	20	5.0
Phorate	24	5	0	29	6.8
Carbaryl	24	2	0	26	6.5
Parathion	13	2	0	15	3.8
Aldrin	13	2	0	15	3.8
Aldrex	6	6	0	12	3.0
Parahep	3	2	0	5	1.3
Parahep and Banvel	2	0	0	2	.5
Untreated	40	3	1	44	11.0

and corn planted. The soil samples were left in the greenhouse until February 20, when they were examined for various stages of the northern corn rootworm. It required only 3 days to wash the insects out of these 40 samples with the special washer equipment.

Table 3 indicates which insecticides have a long residual effectiveness and which break down fairly rapidly, as well as the potential 1967 corn rootworm population. The chlorinated hydrocarbon insecticides alone or in combination with parathion and parathion alone appeared to be very effective in reducing the population for 1967. It is possible that the parathion may have had some effect upon the adults when they entered the soil to deposit eggs. It appears that Bux does not have a long residual period. These data also indicate that the insect is not highly resistant to aldrin.

Field 4: The data in Table 4 were obtained from soil cores taken from a field near Van Wert, Ohio, where different insecticides were applied to determine their effectiveness against the corn rootworm. This field had been in continuous corn for as long as 10 years. On December 14, 1966, one soil core was taken from each treatment. The soil was taken into the greenhouse, potted, and planted to corn. From February 27 to March 1, 1967, the soil was examined for rootworm specimens. It took less than 3 days to wash the larvae out of the soil with the new washing method. The field was sampled again in July 1967 to determine the actual larval population on the small corn plants.

The data show that insecticides applied in the row had slightly more residual effect than when they were applied as a broadcast treatment (see treatments 1-2, 6-8, and 20-21). The basal treatment appeared to have more residual effect than the row treatment (see treatments 10, 14, and 17). The heavier rates of application had more residual than the light-

TABLE 4.—Residual Effectiveness of Insecticides Applied in Different Formulations, Rates, and Methods of Application near Van Wert, Ohio.

Treatment No.	Name	Formulation	Lb. Act. per A.	Application Method*	Larvae	Pupae	Adults	Total Population per Core
1	6506	10 g.	1	R	33	8	0	41
2	6506	10 g.	3	Br	45	9	0	54
3	Carbaryl	20 g.	2	R	60	9	0	69
4	Disulfoton	10 g.	1	R	50	8	1	59
5	Disulfoton	6 lb./gal.	1	R	20	1	0	21
6	Bux	10 g.	3/4	R	26	13	1	40
7	Bux + Aldrin	7.5 + 10 g.	3/4 + 1	R	0	0	0	0
8	Bux	10 g.	3	Br	25	18	2	45
9	8530	10 g.	1	R	17	6	0	23
10	Dursban	10 g.	1	R	9	6	0	15
11	Dursban	15 g.	1.5	R	2	0	0	2
12	Dursban	4 lb./gal.	1	R	6	2	1	9
13	Dursban	25% WP	1	R	21	3	1	25
14	Dursban	10 g.	1	Ba	8	0	0	8
15	Dursban	10 g.	1/2	Ba	21	0	0	21
16	Dursban	25% WP	1/2	Ba	25	7	0	32
17	Dursban	25% WP	1	Ba	3	0	0	3
18	M 2484 EDB	10 lb./gal.	4	Ba	26	1	0	27
19	Phorate + 47470	7.5 + 7.5 g.	1 + 1	R	35	3	0	38
20	10242	10 g.	1	R	10	5	0	15
21	10242	10 g.	3	Br	28	4	1	33
22	Heptachlor	2 lb./gal.	1	Ba	0	0	0	0
23	Heptachlor	2 lb./gal.	1	Ba	0	0	0	0
24	Diazinon	14 g.	1	R	41	20	0	61
25	Baygon	5 g.	1	R	2	11	0	13
26	Baygon	5 g.	1/2	R	24	6	0	30
27	2790	5 g.	1	R	10	3	0	13
28	25141	10 g.	1	R	2	0	0	2
29	25141	10 g.	1/2	R	31	2	0	33
30	37289	10 g.	1	R	19	2	0	21
31	Parathion	10 g.	1	R	24	10	0	34
32	5032	10% EC	1	R	62	22	4	88
33	Untreated	—	—	—	35	8	1	44

*R=Row, Br.=Broadcast, Ba=Basal.

TABLE 5.—Residual Effectiveness of Different Insecticides and Potential 1967 Corn Rootworm Populations Near Van Wert, Ohio.

Treatment	Population Larvae	Pupae	Adults	Total	Average Population per Core
Bux	7	11	13	31	7.8
Chlordane	0	0	1	1	.3
Phorate + 47470	12	23	11	46	11.5
Carbaryl	27	12	0	39	9.8
Aldrex	10	5	0	15	3.8
Phorate	42	24	3	69	17.3
Disulfoton	2	8	14	24	3.5
Untreated	13	14	0	27	6.8

er rates (see treatments 10-11, 14-15, 16-17, 25-26, and 28-29) and the emulsifiable concentrates had more residual than the granular formulations (see treatments 4-5 and 10-12).

Table 4 shows that there was a potential rootworm population of 27.8 larvae per plant in the 1966 stand. In 27 samples taken in the 1967 corn crop, the actual larval population averaged 3.4 per core. The adult population (approximately 30 per plant) and the lodging in some areas indicates that the actual larval population was taken too early to record the true larval population on the 1967 corn plants. Low soil moisture before the larval survey may have been responsible for this low population.

Field 5: The data in Table 5 were obtained from soil cores taken from a field near Van Wert, Ohio, where six insecticides were applied as a basal treatment when the corn was about 4 inches in height and the seventh insecticide (Disulfoton) was applied in the fertilizer at planting time. The soil was collected on December 8, 1966, and planted to corn. After 2 months in the greenhouse, the soil cores were examined for various stages of the northern corn rootworm.

These data are very similar to the data in Table 3. Chlordane, Aldrex, and Disulfoton were still present in the soil when the soil samples were taken in December 1966. Bux, phorate + 47470, and phorate alone apparently had dissipated by late fall because the population in these samples was as great or greater than the population in the untreated soil core.

Field 6: Eight soil cores were taken at random in a field near Van Wert, Ohio, which had been in continuous corn for more than 10 years. These samples were potted in the greenhouse and planted to corn. After

TABLE 6.—Residual Effectiveness of Different Insecticides and Potential 1967 Northern Corn Rootworm Populations Near Urbana, Ohio.

Treatment	Population Larvae	Pupae	Adults	Total	Average Population per Core
Diazinon	10	3	0	13	3.3
Disulfoton	2	0	0	2	.5
Aldrex	0	0	0	0	0
Phorate	5	2	0	7	1.8
Bux	9	5	3	17	4.3
Carbaryl	4	7	0	11	2.8
Aldrin	3	1	1	5	1.3
Untreated	6	3	0	9	2.3

about 2 months, 112 larvae, 42 pupae, and 3 adults were found in the soil cores, indicating a potential population of 19.6 per core.

This field was used in 1967 to evaluate the effectiveness of insecticides applied in the granular form, as an emulsifiable concentrate, and when applied and worked into the soil with different methods. It was expected to provide a good population for evaluating the effectiveness of insecticides.

Field 7: The data in Table 6 were obtained from soil cores from a field near Urbana, Ohio, where the northern corn rootworm had been found resistant to the chlorinated hydrocarbon insecticides. Four soil cores were taken from each treatment on December 19, 1966, placed in the greenhouse, and planted to corn. From March 7 to 9, 1967, the soil was examined for larvae, pupae, and adults of the northern corn rootworm.

Table 6 shows that aldrin, Aldrex, phorate, and Disulfoton residuals were sufficient to kill the larvae which came from the eggs deposited in the treated soil. It is possible that the low populations in these treatments may have resulted from the insecticide residue controlling the female beetles when they entered the soil to deposit eggs. Diazinon had been used by the grower for the past 4 years. These data indicate that Diazinon dissipates much more rapidly than some of the other phosphates.

These studies indicates that: 1) it is possible to obtain information regarding the potential larval population in fields in which research work is planned, and 2) it is possible to obtain more information about the persistence of various insecticides when applied in the row, as a basal application, or as a broadcast treatment, and as a granular, wettable powder, or an emulsifiable concentrate.